Performance Analysis of CSRZ, MDRZ, NRZ and DPSK Modulation Formats for Two Channel WDM Passive Optical Network

Kamalpreet, Miss Bhawna Utreja

***Abstract*— In this paper, we have simulated 2 channel bi directional WDM PON system using CSRZ, NRZ, DPSK and MDRZ modulation formats. System has been analyzed by changing the input power values from -20 to 10dBm. The system is evaluated for 20Gbps bit rate upto 50km in terms of Q factor and eye opening factor. It is found that DPSK is best technique as compared to other modulation formats.**

***Index Terms*— WDM PON, RZ, CSRZ, MDRZ, NRZ, DPSK**

I. INTRODUCTION

Next generation technology needs compatibility with the bandwidth requirements and ease in growth of network expansion. Our current "age of technology" is the result of many brilliant inventions and discoveries, but it is our ability to transmit information, and the media we use to do it, that is perhaps most responsible for its evolution [1]. Progressing from the copper wire of a century ago to today's fiber optic cable, our increasing ability to transmit more information, more quickly and over longer distances has expanded the boundaries of our technological development in all areas [2]The optical network grows since many years to expand the bandwidth capacity. The passive optical network is the ultimate choice to solve the complexities of an access network. PON is used for the transmission of voice, video and data services. It is the network which transmit services from service provider to the end users in fiber to the home networks. In short we can say that PON is the point to multipoint network. Broadband PON, Gigabit PON, Ethernet PON and wavelength division multiplexing PON are the different PON technologies. To meet the demands of compatibility according to need of bandwidth and to support the broadband services the wavelength division multiplexing passive optical network is the best choice. Wavelength division multiplexing passive optical network plays an important role in the realization of flexible access network.

WDM-PON is an optical access network[3][4] in which an OLT is connected to many ONUs through passive devices i.e. splitters and AWGs. AWG is used to overcome the power loss. In bi-directional WDM-PON the data is transmitted in both upstream and downstream continuously.In downstream, all the data in the form of packets are multiplexed by splitters and send to each ONU and in upstream signal from the ONU is de-multiplexed and then transferred to the OLT.

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Modulation in access network is done to improve the transmission quality and spectral efficiency. The BER and Q factor are the parameters which are considered to determine the performance of an optical access network. BER and Q factor can be improved by using proper modulation format. NRZ, RZ, CSRZ, MDRZ, DPSK[5][6] are the different advanced modulation formats used in the WDM-PON. The BER defines as the probability of incorrect identification of a bit by the decision circuit in the receiver and Q factor measures the quality of transmission of signal into the terms of its SNR, higher the value of Q factor the better the SNR and therefore the lower the probability of bit errors [7]. For BER $1*10^{-9}$ the value of Q factor must be greater than and equal to 6. The BER can be calculated by the following equation.

$$BER = \frac{1}{2}\, erfc\left(\frac{Q}{\sqrt{2}}\right)$$

II. PRESENT WORK

Many advanced modulation schemes are used in WDM-PON. In our present work the comparison of all advanced modulation formats like CSRZ, MDRZ, NRZ, DPSK [7] [8] is performed in bi-directional WDM-PON at different distances and different value of power. Out of all modulation formats, we will choose the best technique.

III. SIMULATION SETUP

The simulation setup for bidirectional DPSK WDM-PON is shown in fig1. In the simulation setup, the first subsystem is transmitter part in which the PRBS generator, pulse generator and MZ modulator is used. Second subsystem is WDM MUX in which all inputs all multiplexed into single channel. Then bi-directional fiber is used which work on both upstream and downstream channel. The next subsystem is WDM DEMUX which convert the single channel data on different channels or receivers. The last subsystem is transmitter / receiver as the system is bi-directional. The data is transferred in both direction.

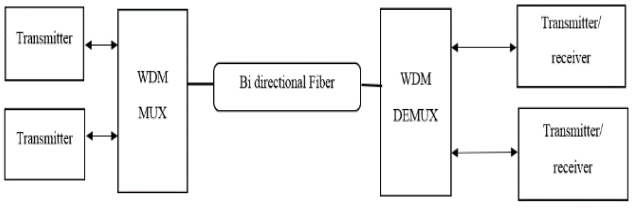


Fig 1. Block diagram of bi-directional wdm-pon

IV. RESULTS

CSRZ, NRZ, MDRZ, DPSK have been compared by varying the input power and the transmission distance in terms of Q factor and eye diagram opening factor.

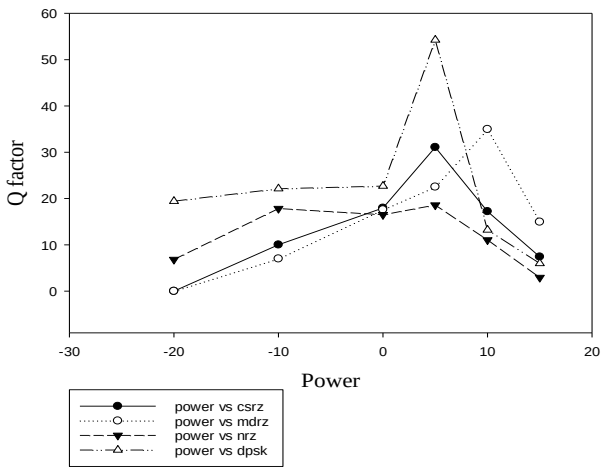
Table 1. Values of Q factor at different power values

Power (in dbm)	Q factor			
	CSRZ	MDRZ	NRZ	DPSK
-20	0	0	6.823	19.4216
-10	10.0193	7.00655	17.8173	22.1365
0	17.9586	17.5837	16.4876	22.7195
5	31.0918	22.539	18.5739	54.2512
10	17.2138	34.9773	11.0331	13.1992

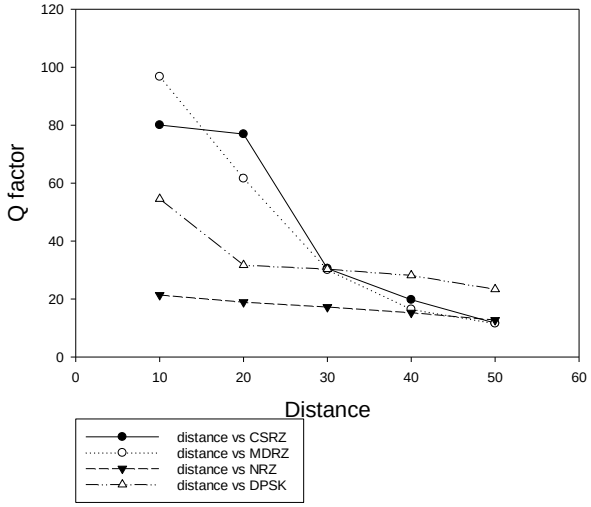
Table 2. Values of Q factor at different distances

Distance (in km)	Q factor			
	CSRZ	MDRZ	NRZ	DPSK
10	80.0884	96.77	21.382	54.5734
20	76.9451	61.6282	18.894	31.7079
30	30.5321	30.0522	17.2129	30.316
40	19.7798	16.4707	15.2712	28.1769
50	11.7022	11.5757	12.7502	23.3681

Fig 2(a) shows the Q factor at varied power value and fig 2(b) shows the variation in Q factor by changing input power

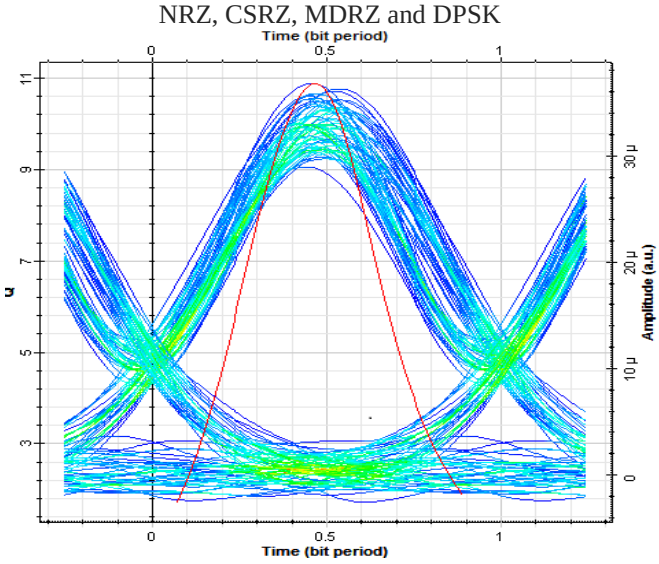


(a)

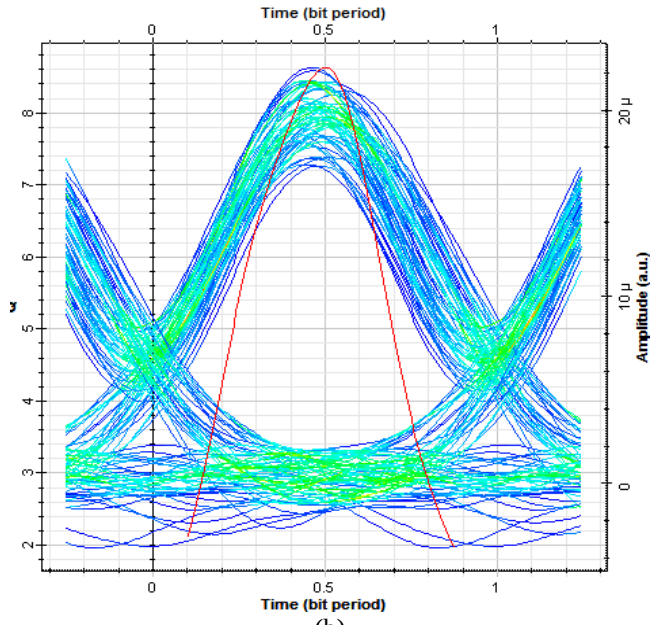


(b)

Fig .2 (a) power v/s Q factor (b) distance v/s Q factor for NRZ, CSRZ, MDRZ and DPSK



(a)



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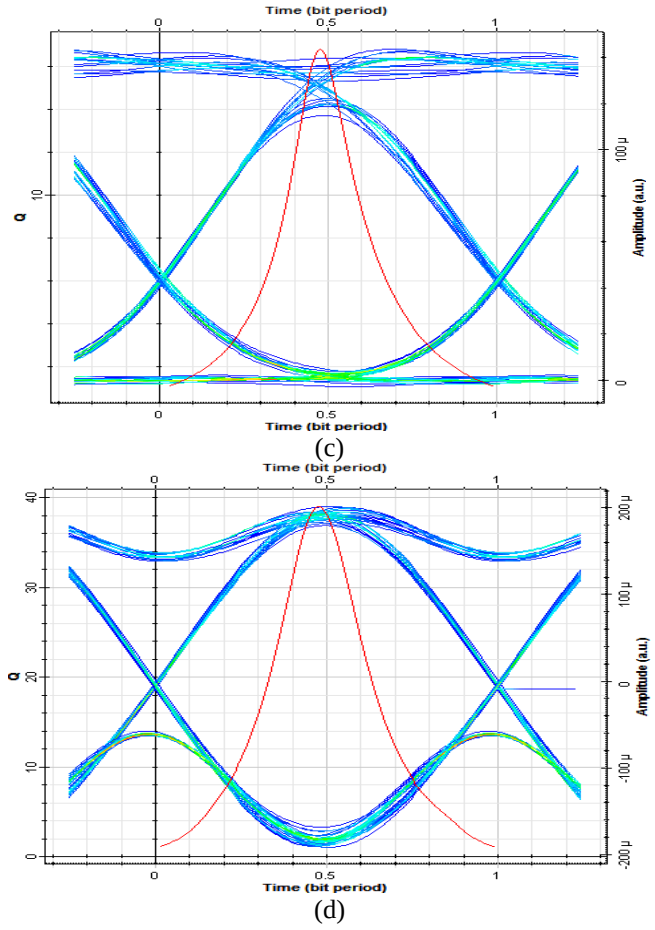

Fig.3 eye diagram of (a) CSRZ (b) MDRZ (c) NRZ (d) DPSK

V. CONCLUSION

In this paper, we have simulated the WDM PON system by changing the values of input power from -20dbm to 10dbm and the fiber distance from 10km to 50 km by keeping the value of data rate 20 Gbps. It is concluded that at low power and at distance 50km the DPSK shows the better performance as compared to other modulation formats.

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